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(54) ELASTOMER COATED FABRIC AND METHOD OF MAKING THE SAME

(71) We, JOHNS-MANVILLE CORPORATION, a corporation organized under the laws of the State of New York, United States of America, having a place of business at Greenwood Plaza, Denver, Colorado, 80217, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to an elastomer coated aromatic polyamide-asbestos or polyester-asbestos fabric and the method for producing the fabric. The fabric is intended for use as a flexible cover material in expansion joints subjected to high temperature service.

Fabrics made of aromatic polyamide yarn such as Nomex (Trade Mark of E. I. Du Pont de Nemours & Co., Inc.) have been used in the manufacture of high temperature cloth for use in expansion joints. However, the aromatic polyamide yarns are shiny, smooth and typically only about .003 inches in diameter. Furthermore, these fabrics have been made with a very close or fine weave thereby inhibiting or preventing the passage of elastomer coatings through the fabric. Thus it is difficult to establish a bond between the aromatic polyamide fabric and an elastomer coating. It is especially difficult to establish a bond between aromatic polyamide fabrics and the fluoroelastomer coatings used for fabrics intended for high temperature applications. In fact, the use of aromatic polyamide fabrics coated with fluoroelastomers at high temperatures has resulted in ply separation between the elastomer and the fabric. Furthermore, since the thickness of the fabric is typically .007 inches and the thickness of this type of coated fabric is typically .030—.035 inches,

these coated fabrics have exhibited poor puncture resistance and are almost impossible to reuse once punctured.

It is an object of the present invention to provide a strong, durable, puncture resistant elastomer-coated fabric for high temperature applications e.g. up to 400°F wherein the coated fabric has a good flexing life. It is a further objective to provide a method of making such an elastomer-coated fabric wherein the bond between the elastomer and fabric is sufficient to prevent ply separation during high temperature service.

According to one aspect of the present invention we provide a coated fabric for high temperature service comprising a fabric layer having an open weave wherein said fabric layer contains aromatic polyamide fibres or polyester fibres intertwined with asbestos yarn so as to form a bulky blended strand, and wherein said fabric layer is coated with an elastomer on both major surfaces with the elastomer extending through the weave openings in said fabric layer to adjoin the elastomer coatings on said major surfaces.

According to the present invention there is also provided a method of manufacturing a coated fabric for high-temperature service comprising applying an elastomer layer to each major surface of an open-weave fabric in such a manner that the elastomer extends through the openings in said weave to join the elastomer layers coating each major surface of said fabric, wherein said fabric layer contains aromatic polyamide fibres or polyester fibres intertwined with asbestos yarn so as to form a bulky blended strand to prevent ply separation during high-temperature service.

The invention will now be described with reference to the accompanying drawing, in which:

Figure 1 is a perspective view of the coated fabric of the present invention with a portion broken away to better illustrate the open weave of the fabric;

5 Figure 2 is a cross-sectional view of the fabric after an elastomer layer has been applied to one major surface of the fabric;

Figures 3a and 3b are longitudinal and transverse views of a typical aromatic poly-
10 amide-asbestos or polyester-asbestos yarn utilized in the fabric; and

Figure 4 and 5 are schematic views of apparatus for manufacturing the elastomer-coated fabric according to the method of the present invention.

Referring now to figure 1, an elastomer-coated fabric 10 of the present invention is shown in perspective with a portion thereof broken away to illustrate a fabric 12 which
20 forms the reinforcing layer of the coated fabric. The coated fabric 10 includes the fabric 12, which is impregnated with a bonding cement compatible with the elastomer, and two elastomer layers or plies 14 and 16
25 respectively which are bonded to each other and the fabric 12.

The fabric 12 is made with an open weave to thereby define openings 18 through the fabric 12 which permit elastomer from the elastomer layers to be forced through the fabric during manufacture. Thus the elastomer layers 14 and 16 on opposite surfaces of the cloth are bonded together as well as to the fabric 12. One example of an
35 open weave fabric is a fabric with a square weave having 12 warp yarns and 12 fill yarns per square inch. Use of an open weave fabric 12 having openings 18 therein through which the elastomer can be forced permits the elastomer layers 14 and 16 to bond both
40 to each other and to the fabric 12.

The yarn used in the cloth is preferably a blended of asbestos yarn and aromatic polyamide or polyester yarn with the blended
45 yarn having a diameter of .030—.035 inches.

As shown in Figures 3a and 3b, the blended yarn is preferably made up of an aromatic polyamide or polyester yarn insert 20 with asbestos yarns 22 wrapped about the insert 20 and one or more aromatic polyamide or polyester yarns 24 wrapped about an over-
50 laying yarns 22. However, the insert 20 and asbestos yarns 22 can be intertwined with the aromatic polyamide or polyester yarns 24 wrapped about and overlying both the insert 20 and yarns 22. In a preferred embodiment the insert 20 is 1200 denier, the overlays 24 are 200 denier and the asbestos yarns are 12 cut yarns, under-
55 writers grade 6230 with a reinforcement such as a cotton strand within the asbestos yarn.
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The utilization of the asbestos yarn with the aromatic polyamide or polyester yarn makes the blended yarn considerably more bulky than the aromatic polyamide or polyester yarn alone. Due to the hairy or fuzzy nature of asbestos yarn, the blended yarn produces a fabric which has improved bonding characteristics with respect to the elastomer but retains the tensile strength, flex life and heat resistance of the aromatic polyamide or polyester yarn (the reinforcing yarn). The yarn, which has a diameter of .030 to .035 inches also presents a larger surface area for bonding than aromatic poly-
65 amide yarns previously used. In addition, due to its larger diameter, the yarn forms a fabric which will not tear as easily as fabrics previously made purely of aromatic poly-
70 amide yarn.
75

While various elastomers and synthetic rubbers can be used, a preferred elastomeric composition used to form layers 14 and 16 is basically a fluoroelastomer combined with other conventional materials which are known
80 to augment the bonding characteristics of the composition. The composition of a preferred elastomer compound, together with a typical mill batch is given in the following table.
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90

ELASTOMER COMPOSITION

	Material	Mill Batches In Pounds	Percent By Weight
5	Low viscosity grade fluoroelastomer (such as—VITON B-50—Trade Mark— marketed by E. I. du Pont de Nemours & Co. Inc.)	55.0	60—80
10	Magnesium Oxide (such as—MAGLITE Y—Trade Mark— marketed by Merck & Co. Inc.)	8.25	4—20
	Medium thermal carbon black (such as—Thermax—Trade Mark—market- ed by R. T. Vanderbilt Co. Inc.)	8.25	4—40
15	Polyethylene Resin (such as—Plaskon 8416—Trade Mark— marketed by Allied Chemical Corporation, Plastics Div.)	1.10	0.5—10
20	Diamine (such as Dirk #3—trade name—marketed by E. I. duPont de Nemours & Co. Inc.)	1.65	0.5—6
25	Polyester Liquid (such as—Harflex 330—trade name— marketed by Wallace & Tiernan Incor- porated, Harchem Div.)	1.65	0.0—15
		<hr/> 75.90	<hr/> 100.00

- The constituents of the elastomeric compound can vary as shown in the above table. However, the preferred composition in approximate percentages by weight comprises fluoroelastomer—72.50% Magnesium Oxide—10.85% MT Carbon Black—10.85% Polyethylene Resin—1.44% Diamine—2.18% and Polyester Liquid—2.18%. The preferred elastomeric composition has the following physical characteristics after a cure of 20 minutes at 324°F plus
- a bake at 250°F for one hour, 300°F for one hour, 350°F for one hour and 400°F for seventeen hours: tensile strength 1,500 psi min.; elongation 300% min.; modulus at 300%—1,300 min.; Shorer A hardness 70±5; and specific gravity 1.88±.03.
- The bonding cement with which the fabric is impregnated prior to the application of the elastomer layer has a composition by weight as shown in the following table.

CEMENT

	Material	Batch In Pounds	Percent by Weight
50	Elastomer composition	30	10—30
	Methyl Ethyl Ketone	90 (12 gals)	35—60
	Methyl Iso-Butyl Ketone	30 (4 gals)	20—45
55		<hr/> 150 (approx. 20 gals)	<hr/> 100

- The preferred composition of the above cement in approximate percentages by weight is 20% of the elastomer compound forming layers 14 and 16, 60% Methyl Ethyl Ketone and 20% Methyl Iso-Butyl Ketone.
- Referring now to figures 4 and 5, a calender 26 for producing the coated fabric 10 of the present invention is illustrated. The calender includes an upper roll 28, a center roll 30 and a lower roll 32. The elastomer to be applied to the fabric 12 is

first passed between the upper roll 28 and the center roll 30 after which it is carried by the center roll 30 into contact with the fabric 12 as the fabric 12 and the elastomer pass between the center roll 30 and the lower roll 32.

The rolls 28, 30 and 32 are heated to maintain the plasticity of the elastomer during its application to the fabric. The optimum temperature for the elastomer during application will depend on the type of elastomer being applied to consequently the operating temperature of the rolls 28, 30, and 32 will also depend on the type of elastomer utilized. However, if the temperatures of the rolls are too low the elastomer will not retain its plasticity and the elastomer will not flow properly into the openings 18 of the fabric 12. If the temperatures of the rolls 28, 30 and 32 are too high the elastomer will stick to the rolls rather than being picked up by the fabric. Consequently, the temperature of the rolls 28, 30 and 32 must be maintained within certain limits for a particular elastomer to ensure it will be picked up by the fabric 12. In addition to ensure that the elastomer will adhere to the center roll 30 rather than roll 28 after passing between rolls 28 and 30, center roll 30 is kept at a higher temperature than upper roll 28. Thus the elastomer passes through rolls 28 and 30, and is carried by roll 30 into contact with the fabric 12. When applying a fluoro-elastomer, the upper roll 28 is maintained at approximately 100°F, the center roll 30 at approximately 105 to 110°F and the lower roll 32 at room temperature to 100°F.

During application of the elastomer, the center roll 30 and lower roll 32 are driven at the same or substantially the same speed. The upper roll 28 is driven at a slower speed so that the elastomer is worked to maintain its plasticity as it passes between the upper roll 28 and the center roll 30. When applying a fluoroelastomer, the center and lower rolls are driven to impart linear speeds of 9 feet \pm 1 foot/minute to the peripheral surfaces of the rolls. The upper roll 28 is driven by the elastomer through friction as the elastomer is pulled through the rolls 28 and 30 by the center roll 30.

The fabric 12 is first dried to eliminate any moisture that may have collected on or in the fabric. Next, the fabric 12 is passed through a conventional coating machine wherein the fabric is sprayed, dipped or otherwise impregnated with the bonding cement. After the coating process the fabric 12 is 18 to 25% by weight, cement. Prior to applying the elastomer compound to the fabric 12 by calendering, the coated fabric 12 is dried, e.g., by maintaining it at room temperature for 24 hours. In addition, the selvege is removed since the selvege is more

bulky than the remainder of the fabric and would cause the fabric to shift as it passes through the rolls during calendering.

After it has been prepared as outlined above, the fabric 12 from roll 34 is then passed between the center roll 30 and the lower roll 32. As the fabric 12 passes between these rolls, the layer 14 of the elastomer composition is applied to the upper surface of the fabric. The elastomer composition is applied by first heating the elastomer composition to plasticize the elastomer. Then, the elastomer is passed between the upper two rolls 28 and 30 of the calender and around the central roll 30 until it is picked up by the fabric 12. The spacing between the top roll 28 and the center roll 30 is such that the thickness of elastomer layer 14 applied during the first pass of the fabric 12 is sufficient to provide an adequate cover for the fabric plus penetration of the layer into the fabric. The spacing between the center roll 30 and the bottom roll 32 is such that the elastomer compound is forced into the openings 18 of the fabric 12 at least half way through the fabric, but preferably flush with the opposite surface of the fabric. For example, with a fabric .030—.035 inches thick, the coated thickness of the fabric, as it emerges from the calender after the first pass, is between .070 and .075 inches thick. After the fabric passes between the rolls 30, 32 and the elastomer composition is applied thereto, a silicone treated paper liner 36 from roll 38 is applied to one surface of the coated fabric to prevent the elastomer from adhering to the underside of the fabric as it is being wound into a roll 40. Then, the coated fabric is wound into the roll 40 and the excess rubber is trimmed therefrom to ready the fabric for the next pass through the calender.

For the second pass, the fabric 12 is unwound from roll 40, the paper liner 36 is removed and the fabric 12 is again passed between rolls 30 and 32 with the uncoated surface facing upward. A second layer 16 of elastomer is applied to the upper surface of the fabric 12 with the elastomer being forced into the openings 18 of the fabric 12 until the elastomer from the second layer 16 meets the elastomer from the first layer 14. The spacing between the top roll and the center roll is again such that the thickness of the second ply is sufficient to provide an adequate cover for the fabric plus the penetration of the fabric required for layer 16 to meet layer 14. However, the spacing between the center roll 30 and the bottom roll 32 is such that the coated thickness of the fabric after the second pass is the thickness desired e.g., between .090 and .105 inches for an expansion joint. After the second pass of the elastomer-coated fabric

through the calender 26, excess elastomer is trimmed from the coated fabric and the coated fabric 10 is passed through a trough 42 of fine water-ground mica. The mica is deposited on both surfaces of the coated fabric to prevent the elastomer from adhering to a rubberized cloth liner 44 which is subsequently introduced between adjacent convolutions of the coated fabric as it is wound onto a drum 46. The rubberized cloth liner 44 is maintained under tension as it is wound on the drum 46 with the coated cloth 10 in such a manner that the elastomer-coated fabric 10 is maintained under compression. Due to the fact that the coated fabric 10 is maintained under compression, the elastomer composition from layers 14 and 16 will flow to fill any void areas in the coated fabric while the coated fabric is being cured on the drum 46. Furthermore, the rubberized cloth liner has a textured surface which is imparted to the coated fabric during the cure.

In the preferred embodiment of the present invention, the coated fabric is vulcanized by subjecting it to steam under 60 pounds pressure for five hours. This effects a partial cure of the coated fabric 10 so that the cure of the fabric 10 is completed while the fabric is in service. Thus, the fabric can better conform to a required configuration for a specific use.

In the preferred embodiment the elastomer is a fluoroelastomer. The fabric is made of aromatic polyamide-asbestos or polyester-asbestos and has a thickness of .030—.035 inches. The coated fabric weighs between 8 and 9 pounds per square yard and has a thickness between .090 and .105 inches. Due to the thickness of the fabric 12 and its coatings 14 and 16, the coated fabric 10 exhibits a great resistance to puncture.

Due to the penetration of the fabric 12 by the elastomer layers 14 and 16, the layers 14 and 16 do not separate from the fabric. In addition, with the elastomer layers extending through the fabric, the elastomer encapsulates the aromatic polyamide-asbestos or polyester-asbestos yarns of the fabric layer 12 to reduce friction between the blended yarns and the yarns forming the blended yarns.

WHAT WE CLAIM IS:—

1. A coated fabric for high temperature service comprising a fabric layer having an open weave wherein said fabric layer contains aromatic polyamide fibers or polyester fibers intertwined with asbestos yarn so as to form a bulky blended strand, and wherein said fabric layer is coated with an elastomer on both major surfaces with the elastomer extending through the weave openings in said fabric layer to adjoin the elastomer coatings on said major surfaces.

2. A coated fabric as defined in Claim 1 wherein said elastomer is a fluoroelastomer.

3. A coated fabric as defined in Claim 1 or Claim 2 wherein the fabric layer has a square weave with twelve yarns and twelve fill yarns per square inch.

4. A coated fabric as defined in any one of Claims 1—3 wherein the fabric layer is impregnated with a bonding cement intermediate said fabric and said elastomer.

5. A coated fabric as defined in any one of Claims 1—4 wherein the elastomer is initially only partially cured.

6. A coated fabric as defined in any one of Claims 1—5 wherein said elastomer comprises, in approximate percentages by weight, 72.5 per cent fluoroelastomer; 10.85 per cent magnesium oxide; 10.85 per cent carbon black; 1.44 percent polyethylene resin; 2.18 per cent diamine; and 2.18 per cent polyester liquid.

7. A coated fabric as defined in any one of Claims 4—6 wherein said bonding cement comprises, in approximate percentages by weight, 20 per cent of said elastomer; 60 per cent methylethylketone; and 20 per cent methyl isobutylketone.

8. A coated fabric as defined in any one of Claims 1—7 wherein the asbestos yarn comprises twelve cut yarns, underwriters grade 6230, having a reinforcement strand within the asbestos yarn.

9. A method of manufacturing a coated fabric for high-temperature service comprising applying an elastomer layer to each major surface of an open-weave fabric in such a manner that the elastomer extends through the openings in said weave to join the elastomer layers coating each major surface of said fabric, wherein said fabric layer contains aromatic polyamide fibers or polyester fibers intertwined with asbestos yarn so as to form a bulky blended strand.

10. A method of manufacturing a coated fabric as defined in Claim 9 wherein said open weave has twelve warp yarns and twelve fill yarns per square inch.

11. A method of manufacturing a coated fabric as defined in either one of Claims 9 and 10 further including impregnating said fabric layer with a bonding cement prior to applying said elastomer layer.

12. A method of manufacturing a coated fabric as defined in any one of Claims 9—11 wherein said elastomer is a fluoroelastomer.

13. A method of manufacturing a coated fabric as defined in any one of Claims 9—12 wherein the asbestos yarn comprises twelve cut yarns, underwriters grade 6230, having a reinforcement strand within the asbestos yarn.

14. An elastomer coated fabric containing aromatic polyamide or polyester fibers intertwined with asbestos yarn substantially as

herein described with reference to, and as shown in, the accompanying drawings.

15. A method of making the produce defined in Claim 14, said method being substantially as herein described with reference to the accompanying drawings.
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